QUORUM SENSING ESSAY

Have you ever wondered how cells know when to do a certain task, or how viruses can make you sick? Did you know, that not only could Eukaryotic cells communicate, but also bacteria? Matter of fact, cells and bacteria both use the same way to communicate, but have different intentions. From flu viruses to muscle cells, they all use a system called quorum sensing.

Quorum sensing is the regulation of gene expression based on the cell or bacteria population density. This is how the cells or bacteria communicate. They produce activator proteins that go to other cells and make more activator proteins

The proteins are called autoinducers, which are signal molecules that the cell spits out. When an autoinducer is sensed nearby a cell, it results to a change in gene regulation. This makes the cell change a gene. Usually when an autoinducer is sensed nearby, the cell will make another signal molecule that will then go to another cell. This process then repeats and repeats.

The cells keep taking count of how many autoinducers come in and out, and that is how the measure how many cells there are around. If there were only a few autoinducers around, the cell would know that there are not many other cells producing bacteria and would keep producing signal molecules. If there are enough signal molecules, the area has reached quorum. This means that there are enough cells around in a given area. All of the cells or bacteria will act together to preform a specific function. It would be like once the area has reached quorum, all of the bacteria in a squid’s belly would light up all at once so that the squid can become invisible and nobody would notice the squid, and the bacteria get to feast on the food that the squid eats. This is a symbiotic relationship. Or, it could be that once the area has reached quorum, all of the viruses in the host will release a chemical all at once that would make the host sick.

Every different species of bacteria have different signal molecules they produce to communicate with each other. All of the autoinducers are similar enough that they originated from the same ancestor, but so different that they cannot come in contact with other cells that do not have the same contraption to take in the signal molecules. It is like how humans all came from the same ancestor, but we speak different languages and have different forms of communicating to each other. One person may speak French while the other speaks English. The English person can understand other people that speak their language, but when other people not their language talk to them, the English person can hear them and somewhat understand, but does not fully understand. Bacteria not only have a machine that takes in their signal molecules, but also an international system that can take in other bacteria’s signal molecules. This is so that the bacteria can keep tabs on how many of the other bacterial species there are. The bacteria might not want to preform the function if there are too many other bacteria around. Or if there are too many other bacteria around, it might have to make an escape. It is always good for the bacteria to know how much of its species there are and also other bacterial species.

Scientists wanted to replicate these molecules so when the “signal molecule” enters the mechanism, it could potentially shut down the contraption and not let the bacteria communicate with each other. If the bacteria can’t measure the cell density, then it won’t know how many of it there are and they won’t preform the function. If this happened to all of the bacterial specie, then all of the bacteria wouldn’t be able to communicate with each other. Bonnie Bassler is trying to figure out how to change the quorum sensing so that the bacteria won’t be able to communicate between each other.

“Now, Bassler’s team is trying to figure out how to disrupt quorum-sensing discourses so that bacteria can no longer communicate. A successful strategy could potentially be used for antimicrobial therapy. Recently, her team began working on understanding and disrupting quorum sensing in bacterial biofilms” As stated in HHMI.

Quorum sensing is the regulation of gene expression based on the density of the area. The cell measures the density of autoinducers around, and determines if the area has reached quorum. If there are enough auto inducers around, then the area has reached quorum. The cell or bacteria then produces a specific function. Inside the cell or bacteria, there is a contraption that is used to sense signal molecules that come in the contraption. The signal molecules can’t enter the cell, so a mechanism takes the signal molecule in. When a signal molecule comes in, this activates a protein, which activates another protein, releasing another signal molecule. One of the proteins is called TraR. The protein also binds the DNA and activates gene expression. This process repeats until there is enough signal molecules that the area has reached quorum. Once the area has reached quorum that is when the cell or bacteria have enough of their species to act together at once.

There are at least 4 steps in the quorum sensing system. The first step is the production of the autoinducers. The second step is the release of the autoinducers. No matter what, cells and bacteria are always releasing signal molecules. They can release the actively or passively. Releasing the signal molecules actively is when the molecule comes into the system activating the protein that makes another signal molecules. Passively making the signal molecules is just releasing the signal molecules into the area. The signal molecules just wander and then go into another cell or bacteria. The third step is the recognition of the signal molecules when they go inside of the contraption. This is when the autoinducer turns on the machine. Then the protein activates the other protein, which leads to the last step, the change in gene regulation.

Before, the studying of quorum sensing started in the 1960’s. They saw that a marine bacterium named Vibrio Fischeri was lighting up in the belly of a squid. Back then; they thought that the bacteria contained an inhibitor of luminescence, which was removed by the bacteria when larger numbers were present. It was then later shown that it wasn’t the removal of an inhibitor, but instead it was the accumulation of an activator molecule called an autoinducer. From the Nottingham website: it says “This molecule is made by the bacteria and activates luminescence when it has accumulated to a high enough concentration.” They then realized that the bacteria are able to sense their cell density by monitoring the autoinducer concentration. This system was then called quorum sensing. Ever since the experiment and study of the squid, this followed up to the basic model for quorum sensing in not only V. fischeri, but also in other similar quorum sensing systems.

Now Bonnie Bassler’s team is trying to find a way to disrupt quorum sensing so that bad bacteria or virulence cannot communicate between each other. This would make it so that the bacteria do not know how many autoinducers there are around, which means they wouldn’t be able to calculate how many of them there are. This means they would not know if there are enough of them to send out the toxics and make the host sick. They wouldn’t be able to produce the function, and if they did there might not be enough of them to make the host sick, therefore the immune system of the host will destroy them. Or, the virus never releases the toxins because they don’t know the density of the area.

THANKS FOR READING

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